of the motion to these lines. Ampère, on the other hand, supposed the magnet to be made up of transverse electric currents (chap. vi.); and had deduced all the facts of electro-dynamical action, with great felicity, from this conception. The question naturally arose, in what manner, on this view, were the new facts of magneto-electric induction by motion to be explained, or even expressed?

Various philosophers attempted to answer this question. Perhaps the form in which the answer has obtained most general acceptance is that in which it was put by Lenz, who discoursed on the subject to the Academy of St. Petersburg in 1833.[2] His general rule is to this effect: when a wire moves in the neighborhood of an electric current or a magnet, a current takes place in it, such as, existing independently, would have produced a motion opposite to the actual motion. Thus two parallel *forward* currents move towards each other:—hence if a current move towards a parallel wire, it produces in it a *backward* current. A moveable wire conducting a current *downwards* will move round the north pole of a magnet in the direction N., W., S., E:—hence if, when the wire have in it no current, we move it in the direction N., W., S., E., we produce in the wire an *upward* current. And thus, as M. de la Rive remarks,[3] in cases in which the mutual action of two currents produces a limited motion, as attraction or repulsion, or a deviation right or left, the corresponding magneto-electric induction produces an instantaneous current only; but when the electrodynamic action produces a continued motion, the corresponding motion produces, by induction, a continued current.

Looking at this mode of stating the law, it is impossible not to regard this effect as a sort of reaction; and accordingly, this view was at once taken of it. Professor Ritchie said, in 1833, "The law is founded on the universal principle that action and reaction are equal." Thus, if voltaic electricity induce magnetism under certain arrangements, magnetism will, by similar arrangements, react on a conductor and induce voltaic electricity.[4]

There are still other ways of looking at this matter. I have elsewhere pointed out that where polar properties co-exist, they are gene-

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[2] *Acad. Petrop.* Nov. 29, 1833. *Pogg. Ann.* vol. xxxi. p. 483.

[3] *Traité de l'Electricité*, vol. i. p. 441 (1854).

[4] On the Reduction of Mr. Faraday's discoveries in Magneto-electric Induction to a General Law. *Trans.* of R. S. in *Phil. Mag.* N.S. vol. iii. 37, and vol. iv. p. 11. In the second edition of this history I used the like expressions.